STATE OF ILLINOIS

STATE GEOLOGICAL SURVEY

FRANK W. DE WOLF, Director

Cooperative Coal Mining Series

BULLETIN 16

COAL RESOURCES

OF

DISTRICT II (Jackson County)

BY

GILBERT H. CADY

Field work by G. H. Cady, F. H. Kay, K. D. White, and others

ILLINOIS COAL MINING INVESTIGATIONS

Prepared under a cooperative agreement between the Illinois State Geological Survey, the Engineering Experiment Station of the University of Illinois, and the U. S. Bureau of Mines.

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The Forty-seventh General Assembly of the State of Illinois, with a view of conserving the lives of the mine workers and the mineral resources of the State, authorized an investigation of the coal resources and mining practices of Illinois by the Department of Mining Engineering of the University of Illinois and the State Geological Survey in cooperation with the United States Bureau of Mines. A cooperative agreement was approved by the Secretary of the Interior and by representatives of the State of Illinois.

The direction of this investigation is vested in the Director of the United States Bureau of Mines, the Director of the State Geological Survey, and the Director, Engineering Experiment Station, University of Illinois, who jointly determined the methods to be employed in the conduct of the work and exercise general editorial supervision over the publication of the results, but each party to the agreement directs the work of its agents in carrying on the investigation thus mutually agreed on.

The reports of the investigation are issued in the form of bulletins, either by the State Geological Survey, the Engineering Experiment Station, University of Illinois, or the United States Bureau of Mines. For copies of the bulletins issued by the State Geological Survey, address State Geological Survey, Urbana, Illinois; for those issued by the Engineering Station, address Engineering Station, University of Illinois, Urbana, Illinois; and for those issued by the U. S. Bureau of Mines, address Director, U. S. Bureau of Mines, Washington, D. C. (See list at end of book.)

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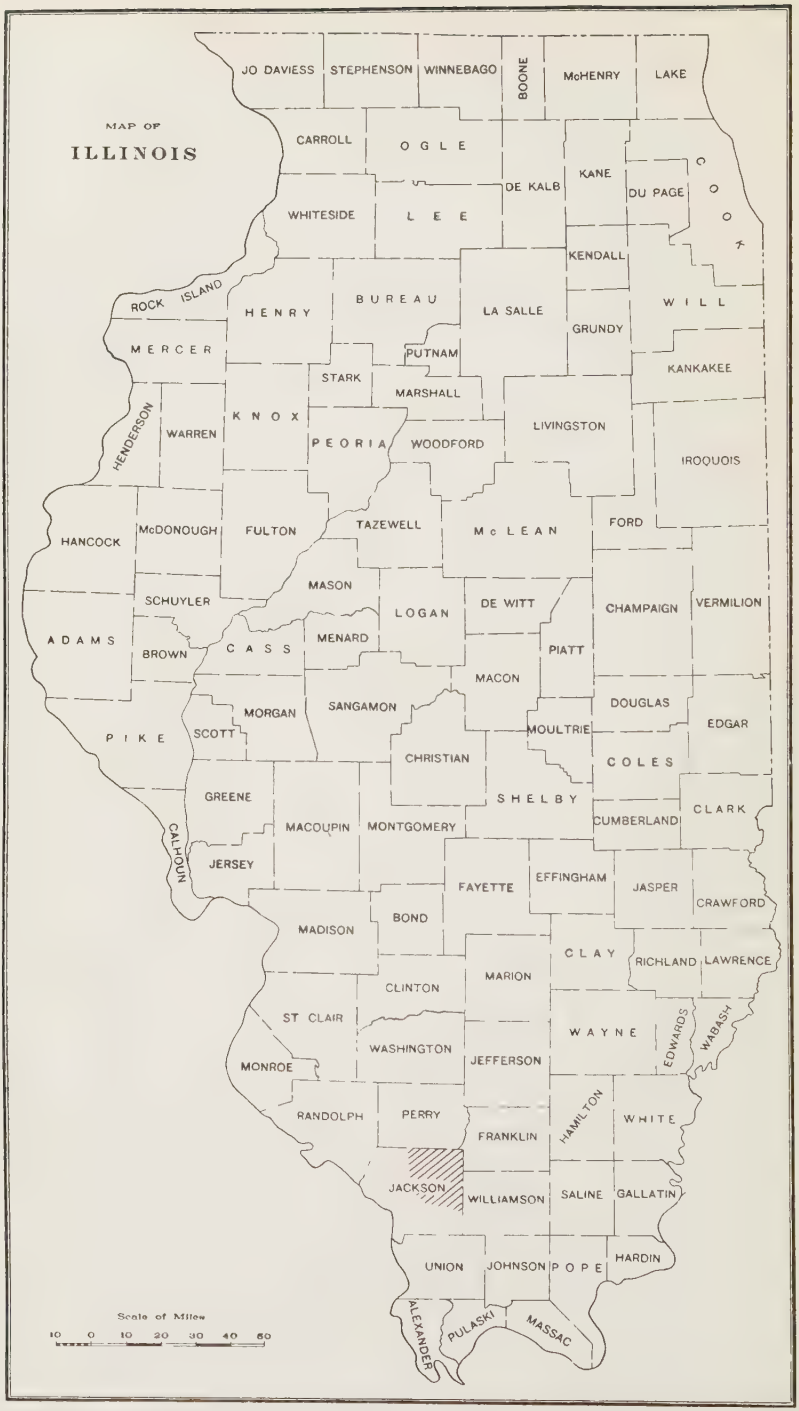


FIG. 1.—Map showing area of District II as covered by this report.

COAL RESOURCES OF DISTRICT II

By G. H. Cady

CHAPTER I—INTRODUCTION

Economic Importance of Area

District II of the Illinois Coal Mining Investigations includes that part of Jackson County (fig. 1) underlain by coal No. 2 (Murphysboro coal). This district, the smallest in the State, has the distinction of furnishing coal of highest calorific value for Illinois; as the area underlain by workable coal is restricted there are but few mines, so that the production from District II is comparatively small. A total output from 6 shipping mines for the year ending June, 1916, was 625,964 tons.

The northeastern part of Jackson County is underlain also by two other beds of coal, No. 5 or Harrisburg and No. 6 or Herrin, the upper one of which is being mined at a number of places; but both are of commercial value.

Acknowledgments

The description of the coal resources of District II, which constitutes the subject matter of this bulletin, is based upon field investigations by members of the State Geological Survey and U. S. Geological Survey, upon the text and maps of the Murphysboro-Herrin folio of the Geologic Atlas of the U. S. Geological Survey, by E. W. Shaw and T. E. Savage, which has been largely drawn upon, and upon the tabulation and study of data derived from about 180 drilling records furnished the State Geological Survey by various companies operating in the district. Special acknowledgment is made of the use of field notes of Messrs. K. D. White and F. H. Kay, collected in 5 mines selected for examination by the Investigations. Thanks are due to the operators of the district for information furnished the Survey and for kindly cooperation in opening the mines to examination.

The bulletin is one of a series of similar publications prepared by the State Geological Survey in cooperation with the Mining Experiment Station of the University of Illinois and the U. S. Bureau of Mines, dealing with the coal resources of the various districts of the State. The districts examined by the Investigations are listed in the *Preliminary Bulletin, Illinois Coal Mining Investigations.*

CHAPTER II—GEOGRAPHY

Location

District II lies entirely within the boundaries of Jackson County, but is not coextensive with the county. The north and east boundaries of the district coincide with the boundaries of the county. The boundary to the southwest is marked by the outcrop of coal No. 2 along an irregular and more or less indefinite line running north from a point about 5 miles west of Murphysboro and southeast toward Carbondale. Small outliers of coal No. 2 lie to the west between the main line of outcrop and the bluff of the Mississippi, the most important of which is in the vicinity of Ava.

District II lies south of District VII and west of District VI, as defined by the Cooperative Investigations. The most important portion of the district lies in the vicinity of Murphysboro within the boundaries of the Murphysboro and Herrin quadrangles, the geological report upon which has already been published.[1]

Topography

The Murphysboro and Herrin quadrangles exhibit two types of topography, according to Shaw and Savage—the higher hills bordering the Mississippi and the interior lowlands. District II lies almost wholly within the interior lowlands, only the western part near the outcrop of coal No. 2 being in the hilly portion of the county. The interior lowlands have an altitude of about 400 to 480 feet, whereas the altitude of the hilly country south of Ava reaches 720 feet. West of the district and beyond the outcrop of coal No. 2 the county is underlain largely by the resistant Pottsville sandstone. The highest hills here reach an elevation of about 750 feet.

The interior lowlands have been described as follows:[2]

> The principal features of the interior plain are (1) the low hills; (2) the slightly rolling divides 420 to 460 feet above sea level; (3) the broad terraces along the principal streams, lying for the most part at 390 to 410 feet; (4) the flood plains, at 360 to 385 feet; and (5) the deep river and creek channels cut 20 feet or more below the flood plains. On each stream the terraces, flood plain, bottom of the channel, and surface of the bed rock below the channel all converge upstream.
>
> The terraces are the upper surfaces of valley deposits which attain a maximum thickness of about 110 feet along the courses of the rivers. The terraces seem to have been formed by the deposition of material by temporarily obstructed streams that once emptied into the Mississippi at a level considerably below that of the present channels.

[1] Shaw, E. W., and Savage, T. E., U. S. Geol. Survey Geol. Atlas, Murphysboro-Herrin folio (No. 185), 1912.

[2] Idem, p. 1.

Figure 2 is a sketch map showing the area covered by these terraces bordering Big Muddy River and its tributaries and the position of District II. The map is adapted from one appearing in the Murphysboro-Herrin folio.

FIG. 2.—Sketch map showing terraces along Big Muddy River and its tributaries.

GLACIATION

Glacial deposits mantle the hill tops and many hill sides in the more elevated portions of the district, and a covering of yellow loess effects a still further concealment of the bed rock and renders the outcrops of the coal obscure. It is probable that the glacial till, if not the loess of the hilly country extends below the alluvial material of the interior lowlands, as almost all the area was covered at least once by a great ice sheet which left a continuous but a relatively thin mantle of debris which did not greatly modify the surface configuration. This region thus differs from the central and northern parts of the State, which were subjected to the erosion of moving ice for a much longer time and which received thick deposits from an oscillating ice front. Subsequent to glaciation of the region the valleys filled with silt and gravel, forming the extensive terraces now existing along the streams.

Drainage

The run-off of the district reaches the Mississippi through Big Muddy River, of which the two largest tributaries in Jackson County are Beaucoup Creek and Little Muddy River.

The principal streams are, according to Shaw and Savage,[3] similar in profile and in certain other features. Each is naturally separable into three longitudinal divisions. In the first and upper division the streams are about the level of the extensive terraces, the valleys seem normal in all respects, and rock outcrops are numerous. In the second division the floodplains of the streams lie at approximately the same altitude as the terraces and accordingly the valley is broad and swampy. Here the stream flows over the unconsolidated sandy deposit, and rock outcrops are very rare. In the third division the stream lies below the terrace surface. Rock outcrops are absent except where the stream swings to one side of the valley, leaving terraces on the opposite side. The gradient is very low, the banks are of mud or fine silt, the channel is deep, and the floodplain narrow.

Towns and Railroads

The principal towns of the district are Murphysboro and Carbondale, each having several thousand inhabitants. There are numerous smaller towns which depend for their prosperity upon the coal-mining industry, especially in the northeast part of the county east of the outcrop of No. 6 (Herrin) coal. Several railroads traverse Jackson County, and transportation facilities are entirely adequate for the coal industry of the district.

[3]Idem, p. 2.

CHAPTER III—GENERAL GEOLOGY

Stratigraphy

Pennsylvanian series ("coal measures")

General features

The rocks of the Pennsylvanian series contain all the known coal beds in this and the other districts of the State. The series consists of a succession of shales and sandstones, and minor amounts of limestone, clay, and coal. In Jackson County the greatest known thickness of "Coal Measures" or Pennsylvanian rocks is between 1,000 and 1,100 feet. Toward the southeastern part of the State the series attains a thickness of 2,000 feet, the greater thickness being due to the greater thickness of individual formations and to the presence of a greater amount of the upper part of the series than is found in District II, where much material has been removed by erosion.

Underlying the Pennsylvanian series are several series of formations belonging to older systems. Of these the rocks of the Mississippian series are comparatively well known both from drill records and from outcrops not far distant along Mississippi River. Below the Mississippian series lie the rocks of the Devonian system. About 1,300 feet of limestone encountered in the deepest drill hole represents the Devonian, Silurian, and Ordovician systems. Plate II, No. 1, presents a generalized columnar section of the Pennsylvanian rocks in Jackson County, adapted from the Murphysboro-Herrin folio.

The Pennsylvanian series in Illinois has been separated for convenience in study into the following three formations, named in ascending order—Pottsville, Carbondale, and McLeansboro.

Pottsville formation

The upper limit of the Pottsville, which is known with fair accuracy, lies at a very short distance below coal No. 2 (Murphysboro coal), and for convenience the base of the coal has been used by the State Geological Survey as the formation boundary. The following description of the Pottsville formation for the Murphysboro and Herrin quadrangles is adequate for the entire district.[1]

The Pottsville formation is composed principally of sandstone. In the southwestern portion of the area it crops out extensively with a thickness ranging from 420 to 510 feet, and owing to its resistant nature and its uplift it forms very rugged hills.

In the northern and eastern parts of the area the Pottsville generally extends from near the base of the coal No. 2 down to the first limestone and may thus be identified in drill holes by its position. But in some places a sandstone overlying this limestone belongs below the Pottsville, and in such places

[1]Shaw, E. W., and Savage, T. E., U. S. Geol. Survey Geol. Atlas, Murphysboro-Herrin folio (No. 185), p. 6, 1912.

the base of the Pottsville is very difficult to determine, even in outcrops. The formation is generally made up of seven sandstone members separated by layers of shale, though in many places one or more shale members are absent or are represented by sandstone. In such places there appear to be fewer sandstone members. The shale generally contains some thin-bedded or lenticular sandstones and one or more carbonaceous beds or coal seams. All the strata are very irregular; beds of sandstone grade laterally into shale, and hardly any bed holds its physical character throughout any considerable area. The seven main sandstones are not very persistent and are of irregular thickness.

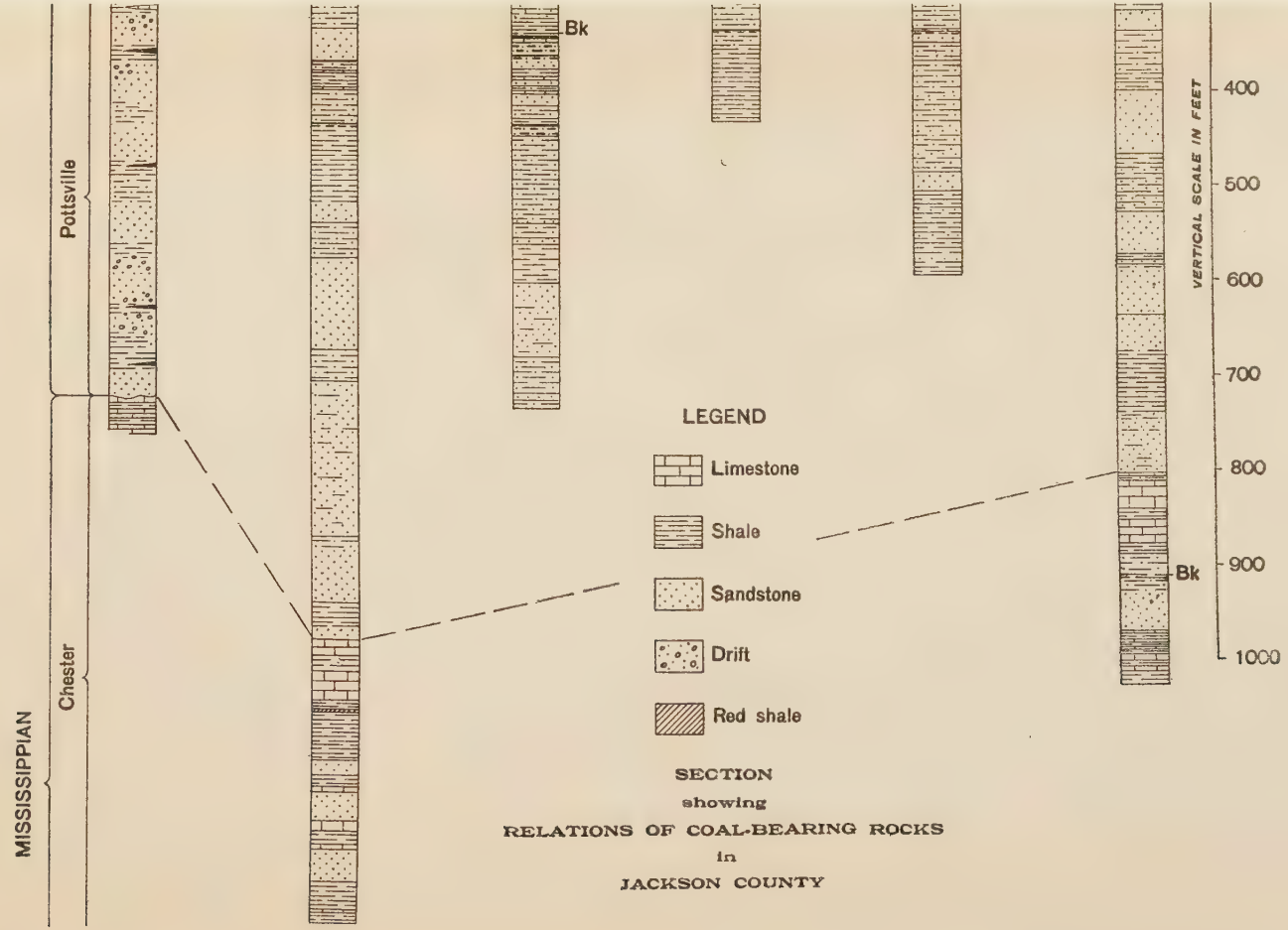
The lowest sandstone, which, in general, is fine grained, creamy white, and relatively soft, has a maximum thickness of 60 feet though locally it seems to be absent. Above it lies 5 to 75 feet of sandy shale locally containing traces of coal.

The second sandstone is 35 to 60 feet thick and the third 50 to 85 feet thick. These two sandstones are considerably more resistant than the first and contain pebbles, especially in their lowermost parts. Throughout most of the area they are separated by a bed of soft shale, ranging in thickness up to about 20 feet, with lenses of sandstone and traces of coal. The upper of the two is overlain by a more or less sandy shale, 1 to 20 feet thick, containing beds of pure sandstone.

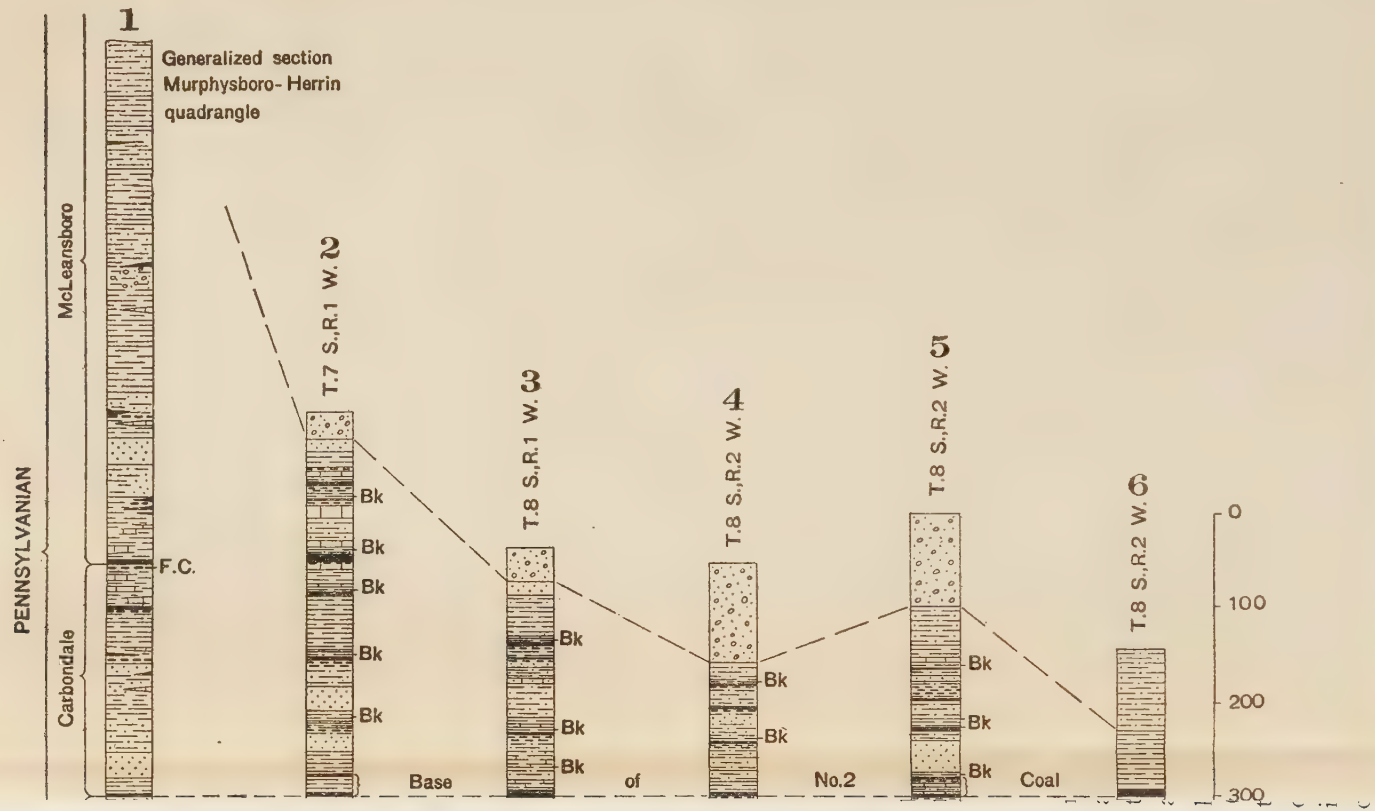
The fourth sandstone measures 45 to 85 feet and the fifth 70 to 100 feet. Both are gray, clean, and hard, and contain a few lenses of shale, and toward the top scattered pebbles. They are separated by an irregular mass of shaly sandstone, from 30 to 90 feet thick, containing lenses of soft shale, and having at the top a fairly persistent coal bed, 2 to 25 inches thick. The fifth sandstone is overlain by 1 to 40 feet of shale and shaly sandstone.

The sixth sandstone is 40 to 80 feet thick and the seventh 20 to 35 feet. Both are conglomeratic, particularly northeast of Ava. The pebbles seem to be concentrated along bedding planes and not scattered irregularly through the mass. The shale with shaly sandstone, between these uppermost sandstones is irregular in thickness, ranging from 3 to 30 feet, and contains one or more lenticular coal beds and commonly masses of iron oxide. At least a part of this shale member is of Mercer age. Near Oraville and on the Mississippi bluffs little conglomerate appears in any layer of the Pottsville, but in other places, as near Sugar Hill school, quartz pebbles are scattered through much of the formation. Between the uppermost sandstone and coal No. 2 there is a 10 to 30 foot shale member with local sandstone layers.

On Plate II are five graphic sections (Nos. 2 to 6) of drilling records of coal or oil borings in Jackson County which show the character of the Pottsville formation. It will doubtless be observed that the seven sandstone members of the Pottsville formation described above are not distinguishable in any of these records. Their relative position and thickness, however, is indicated in the generalized section (Plate II, No. 1). In general the lithologic criteria for the identification of the several sandstone members of the Pottsville formation are of little practical value. In most drill records the base of the Pottsville is placed at the first limestone below the main coal beds and below a considerable thickness of sandstone. The base of the formation is



SECTION
showing
RELATIONS OF COAL-BEARING ROCKS
in
JACKSON COUNTY


1
Generalized section
Murphysboro-Herrin
quadrangle
PENNSYLVANIAN
McLeansboro
Carbondale
F.C.
T.7 S.,R.1 W.
2
T.8 S.,R.1 W.
3
T.8 S.,R.2 W.
4
T.8 S.,R.2 W.
5
T.8 S.,R.2 W.
6
Bk
Base of No.2 Coal
0
100
200
300

undeterminable where the upper formation of the Mississippian series is sandstone or shale; the top is difficult to determine where coal No. 2 is absent.

The coal beds of the Pottsville formation are of no commercial importance. A thin seam 12 inches or less in thickness is not uncommon about 75 feet below the top of the formation (coal No. 2), and some records note a thin bed of 3 or 4 inches about 40 feet below coal No. 2. Otherwise the formation seems to be barren.

CARBONDALE FORMATION

Thickness.—The Carbondale formation includes all the strata from the base of coal No. 2 to the top of coal No. 6 (Herrin coal). The name is taken from the town of Carbondale, Illinois, in the vicinity of which the formation is well exposed. The formation in Jackson County attains a thickness of 254 feet in at least one locality.

Lithologic characteristics.—The formation between coal No. 2 at the base and coal No. 6 at the top of the formation is made up largely of shale and sandstone with several thin layers of limestone and more or less lenticular beds of coal. The shale, which is poorly laminated and claylike, ranges in color from black to dark gray. The sandstone is commonly loosely cemented and rather micaceous, though one or two of the thinner beds are firmly cemented by calcium carbonate. The limestone is hard, gray to bluish gray, and more or less fossiliferous. Some of it has a peculiar brecciated or conglomeratic appearance.

The sequence of the beds composing the formation may be seen in the generalized columnar section on Plate II, No. 1. The succession as found in a coal prospect located in this area is recorded below. This record is reproduced graphically as section No. 2, Plate II. The graphic reproduction includes also part of the adjacent formation above and below and represents the entire log.

Partial record of a drilling showing the character of the Carbondale formation

(See Plate II, No. 2)

Description of strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Coal (Herrin or No. 6)	8	6	158	..
Underclay	1	..	159	..
Limestone	6	..	165	..
Shale	14	..	179	..
Limestone	3	..	182	..
"Slate," black	4	6	186	6
Coal (Harrisburg or No. 5)	4	6	191	..
Shale	58	..	249	..
Limestone	1	..	250	..

Partial record of a drilling showing the character of the Carbondale formation

Concluded

Description of strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Shale, black	3	6	253	6
Coal (No. 4?)	2	..	255	6
Underclay	10	6	266	..
Shale, sandy	22	..	288	..
Sandstone	25	..	313	..
Shale	10	..	323	..
Limestone	1	..	324	..
"Slate," black	3	..	327	..
Coal (No. 3?)	..	6	327	6
Underclay	2	6	330	..
Shale, sandy	5	..	335	..
Sandstone	23	..	358	..
Shale	24	6	382	6
Coal (Murphysboro or No. 2?)	1	10	384	4
Shale	20	2	404	6
Coal (Murphysboro or No. 2?)	2	3	406	9

Correlation.—The following is quoted from the Murphysboro-Herrin folio:[2]

From a study of the fossil plants found in the coal seams and associated strata in the State, David White concludes that the Murphysboro coal is the lowest coal bed in Illinois that falls within the time interval of the Allegheny formation of Pennsylvania. He also concludes that the Herrin coal may be of Freeport age, possibly as high in the stratigraphic column as the Upper Freeport coal, which is the uppermost layer of the Allegheny formation in the Appalachian region. From these correlations it will be seen that the Carbondale formation corresponds in a general way to the Allegheny formation of the Appalachian region.

Coal No. 2 is believed to be of about the same age as the La Salle (No. 2) coal of District I of northern Illinois.

Coal No. 2.—The Murphysboro (No. 2) coal ranges in thickness from 1 to 6 feet or more and is commonly divided into two or more benches. The bed is of somewhat irregular thickness and seems to be absent from considerable area in the northern and eastern parts of the quadrangle. It is also absent throughout most of the hills, whence it has been removed by erosion, but it is workable almost continuously along the foot of the hills. The bed is mined extensively in the vicinity of Murphysboro, and has also been mined 1½ miles northwest of Oraville, at Bryden, at Sato, and at points 1½ miles south of Ava, and 2½ miles southwest of Matthews. At these places the bed is somewhat variable, but there is generally 3 to 4 feet of excellent coal.

In the vicinity of Murphysboro and along the outcrop of coal No. 2 near Sato, the coal occurs in considerable areas as an unbroken seam. The margin of this especially valuable coal is marked either by the outcrop or by a splitting up of the seam by beds of shale of increasing thickness. These irregularities may occur at any place in the bed or at several places at once, but it possibly is found to take place most commonly near the middle of the seam. The rapid variation in thickness of the two benches of coal No. 2 and of the shale parting is illustrated by the following drilling records of borings located in the same section.

Lower part of the Carbondale formation at the east side of the SE. ¼ SW. ¼ sec. 32, T. 8 S., R. 2 W.

		Thickness	
		Ft.	*in.*
Loess and valley filling		30	7
Carbondale formation—			
Shale, yellow clay		10	9
Shale, hard, blue		37	6
Coal	Coal No. 2	2	2
Shale	Coal No. 2	8	4½
Coal	Coal No. 2	3	5¾
Coal, bony	Coal No. 2	..	6
Clay		..	2¾

Lower part of Carbondale formation at the west side of the SE. ¼ SW. ¼ sec. 32, T. 8 S., R. 2 W.

		Thickness	
		Ft.	*in.*
Loess and filling		31	8
Carbondale formation—			
Shale, yellow, soft		5	..
Shale, blue		11	4
Shale, black		..	7
Coal	Coal No. 2	2	5
Coal, bony	Coal No. 2	..	5
Shale, blue	Coal No. 2	35	10
Coal	Coal No. 2	3	2
Shale, blue		4	5
Shale, dark, calcareous		4	..
Sandstone, hard		4	7

Vergennes sandstone member.—The following description is given by Shaw and Savage:[2]

The Murphysboro coal is generally overlain by a seam of clay ("sheepskin"), which is in turn overlain by 20 to 40 feet of shale or in a few places shaly sandstone, which where thickest locally contains a thin coal seam near the middle. This shale is in turn overlain by sandstone or in some places by sandy

[2]Idem, p. 6.

shale, which seems to be persistent though irregular in thickness, ranging from 15 to 45 feet. This sandy member is micaceous, loose, friable, and brownish. Although it is not nearly so resistant as the beds of the Pottsville sandstone, it forms low hills, and 4 miles northwest of Vergennes, in sec. 11, T. 7 S., R. 3 W., it is well exposed on a large hill. The persistent nature of this rock and its importance as a key stratum (as it forms low hills and crops out more extensively than other parts of the Carbondale formation) seems to warrant a special name, and the term Vergennes sandstone member is here proposed.

Strata between Vergennes sandstone member and coal No. 5.— In the folio covering the Murphysboro and Herrin quadrangles is the following description.[3]

Above the Vergennes sandstone member is a bed of clay 5 to 6 feet thick, and overlying the clay and about 55 feet above coal No. 2 there is a persistent coal bed, 6 to 28 inches thick. This coal, which is thin in the northern part of the area and thickens toward the south, is exposed at the surface in the east bank of Crab Orchard Creek, near the northwest corner of sec. 36, T. 8 S., R. 1 W., where it has been mined by drifting. The following section was made at this place:

Section exposed in sec. 36, T. 8 S., R. 1 W.

		Thickness	
		Ft.	*in.*
5.	Sandstone, yellowish-brown, marked with numerous small brown spots	4	6
4.	Limestone, argillaceous, single bed	1	4
3.	Shale, black, fissile	2	8
2.	Coal	2	..
1.	Underclay, gray	1	6

Eight rods north of this exposure 12 feet of sandstone is laid bare in the bank of the creek. One-fourth mile up the creek from the latter point 10 feet of the sandstone overlain by 6 feet of gray sandy shale is exposed.

At the east end of the wagon bridge over Crab Orchard Creek, near the middle of the north half of sec. 2, T. 9 S., R. 1 W., the following succession of strata is exposed:

Section exposed in sec. 2, T. 9 S., R. 1 W.

		Thickness	
		Ft.	*in.*
8.	Limestone, argillaceous, somewhat concretionary	1	..
7.	Shale, black, fissile, containing *Orbiculoidea missouriensis* and dermal tubercles of *Petrodus occidentalis*	3	..
6.	Coal	2	4
5.	Underclay, gray	2	6
4.	Shale, gray	5	6
3.	Shale, gray, sandy	7	..
2.	Sandstone, yellowish gray	8	..
1.	Sandstone, fine grained, shaly	10	..

In the above section the beds numbered 5 to 8 inclusive are the equivalents respectively of those numbered 1 to 4 in the preceding section. Corre-

[3]Idem, p. 7.

sponding beds outcrop about a mile southeast of the bridge over Crab Orchard Creek, in sec. 1 of the same township, where the coal has been stripped for local use. The sandstone bed at this last place, overlying the 1-foot limestone above the coal seam, is 16 feet thick. In a ravine about half a mile north of this point 14 feet of the sandstone, succeeded by 5 feet of shale, is exposed. In some records the sandstone is reported to be about 25 feet thick.

The strata described represent the beds associated with the coal lying about 55 feet above coal No. 2. The sandstone member above the coal is succeeded by a bed of shale 40 to 50 feet thick, commonly more or less sandy and locally a true sandstone. In some places, as 2 miles southeast of Denmark, the central part of this shale contains calcareous and fossiliferous layers of sandstone. * * * .

Above the shale is a bed of clay 5 to 6 feet thick, which is in turn overlain by a 2-foot bed of coal. This coal lies about 80 feet above the coal referred to in the preceding paragraph and 135 feet above coal No. 2. It is overlain by a bed of black, finely laminated shale 3 to 5 feet thick, upon which rests a 1-foot layer of limestone. Above the limestone 40 feet or more of gray shale, locally fossiliferous in the lower part, grades upward into sandstone. * * * The sandstone which overlies the shale has lenses of shale and limestone * * * A bed of clay 1 to 5 feet thick overlies this shale and sandstone, and underlies coal No. 5.

Coal No. 5 and associated strata.—No. 5, or Harrisburg coal, is found in Jackson County east of its outcrop wherever the drill has penetrated to its horizon. It is found underlying only T. 7 S., R. 1 W., and adjacent parts of T. 7 S., R. 2 W., and T. 8 S., Rs. 1 and 2 W. The outcrop which is obscured by the drift lies about three-fourths of a mile west or south of the outcrop of coal No. 6, as shown on the map (Pl. I). The records of 21 drillings in this part of the county that have penetrated the full thickness of the coal show a variation in the thickness between 44 and 70 inches; 3 holes show less than 50 inches, 12 a thickness between 50 and 60 inches, and 6 a thickness greater than 60 inches. The average of 21 measurements is 55 inches.

The following description is given by Shaw and Savage:[3]

The sequence of strata associated with the Harrisburg coal is well exposed in the south bank of a creek in the E. ½ sec. 1, T. 9 S., R. 1 E., where the following section was made:

Section near the middle of the E. ½ sec. 1, T. 9 S., R. 1 E.

		Thickness	
		Ft.	*in.*
5.	Shale, gray, yellowish where weathered	4	..
4.	Shale, soft, gray, calcareous; many fossils	1	2
3.	Limestone, single layer, hard, bluish gray, argillaceous	1	..
2.	Shale, black, fissile, finely laminated; contains numerous more or less round "niggerheads" or iron-stone concretions 8 to 30 inches in diameter	6	9
1.	Harrisburg coal (No. 5)	4	..

The black shale overlying the Harrisburg coal is locally as much as 15 feet thick, but generally its thickness is between 6 and 9 feet. * * *.

A peculiar black laminated shale, such as that above the Springfield coal (No. 5), farther north, generally overlies the Harrisburg coal in this region. In the vicinity of Springfield and in other portions of the State there is, immediately above the Springfield coal seam and at the base of the black shale, a local pyritiferous band a few inches thick, with many fossils, in most places marine, showing the shales to be true marine deposits.

The limestone overlying the roof shale of the Harrisburg coal is 12 to 36 or more inches thick. The limestone is comparatively resistant, and if it were thicker no doubt it would form hills. It outcrops more extensively than any other layer above the Pottsville, the principal exposures being along Beaucoup Creek 2 to 3 miles southeast of Finney and 1 to 2 miles southeast of Denmark. Above the limestone is a thin bed of rather soft gray calcareous shale * * * succeeded by a bed of gray shale, 10 to 14 feet thick, which is generally overlain by a limestone bed 4 to 10 feet thick.

Coal No. 6 and underclay.—Above the limestone last mentioned is the clay underlying coal No. 6. This clay varies in thickness from 1 to 3 feet in this area and generally contains impressions of the roots of a plant, *Stigmaria*. The overlying coal is 7 feet 3 inches to 12 feet 5 inches thick, though the seam where much broken by shale reaches a thickness of 16 feet 9 inches. The average thickness of the bed including the "blue band" in 22 records is 9 feet 6 inches. The coal is characterized by a layer of dirt or bone or shaly coal, known as the "blue band," which lies 18 to 30 inches above the base of the coal. Near the east boundary of the district this shale in places measures 6 to 11 inches, but in most places[4] the "blue band" is much thinner, being rarely over 3 inches in thickness. The approximate outcrop of this coal is shown on Plate I by a broken line. The portion of the county lying south and west of this line represents the area in which the Carbondale formation below coal No. 6 immediately underlies the surficial deposits.

MCLEANSBORO FORMATION

General character.—The McLeansboro formation in southern Illinois is barren of workable coal beds except possibly in small areas, and consists very largely of shale and sandstone. As it is much better developed in adjacent districts than in Jackson County the reader is referred to bulletins describing Districts VI and VII where the formation is discussed in detail. Only in the northeast part of Jackson County is there more than 200 feet of the formation present, and only 5 drill holes out of a possible 27 in T. 7 S., R. 1 W., show so much.

Shale and limestone immediately overlying coal No. 6.—Coal No. 6, or Herrin coal, is overlain by a bed of shale of somewhat variable

[4]See Bulletins 11 and 15, Illinois Coal Mining Investigations.

character 5 to 78 feet in thickness. The shale is described in the drilling records as "clay shale," "sandy shale," and "black slate." One log records 46 feet 8 inches of sandstone above the coal. The black "slate" is commonly found at the top of the shaly strata and in places lies immediately upon the coal. There may be great variation in the succession reported in the same square mile. For instance out of 12 records of drilling in sec. 29, T. 7 S., R. 1 W., one shows "slate" lying above the coal, another records 43 feet of strata between the coal and the black shale, and others show various intervals between these two extremes. The black "slate" is not everywhere present in the section.

Commonly a bed of limestone overlies the strata described in the preceding paragraph. This limestone where it is found within 25 feet of the coal forms the cap rock in the various mines and is commonly encountered in drilling. It has a widespread distribution in Illinois and can be identified by the aid of a small fossil (*Girtyina*) which it contains. In thickness the stratum varies from 1 to 7 feet, the average thickness being 3 or 4 feet.

Where an interval greater than 25 or 30 feet separates the coal from the nearest limestone above, there is some hesitancy in making correlations with the limestone carrying *Girtyina* without additional evidence. The writers of the Murphysboro-Herrin folio believe that where a thick bed of shale overlies the coal the limestone has been removed by erosion. In Bulletin 15 of this series is expressed the belief that the limestone is more or less widespread over southern Illinois and that the underlying shale is of unusual thickness in certain areas. The variation in the thickness of the shale is thought to be due to the difference in the amount of shrinkage of the underlying coal in its consolidation from peat, thicker coal shrinking more than thin coal. Certainly no evidence is at hand to show that the erosion which is conjectured to have removed the black shale and limestone at any place removed any part of the closely subjacent coal.

Strata above the limestone cap rock of coal No. 6.—Overlying the limestone which forms the cap rock of coal No. 6, shale described in the records as "clay shale", "sandy shale", "blue slate", and "fire clay" is recorded commonly about 20 feet thick, but possibly in places not over 10 feet, and elsewhere possibly as much as 45 feet. Above this is a limestone which has an average thickness from 12 to 14 feet but is thinner in some places. It is not recorded in all the logs.

A thin coal 12 to 14 inches in thickness is reported in a number of the drill holes at an interval of 50 to 60 feet above coal No. 6 with another and thinner seam about 10 feet higher. Their distribution,

however, seems to be restricted to a small area. It is thought not improbable that one of these thin coal beds may be the same as the thin seam found 25 to 50 feet above coal No. 6 in District VII and described by Mr. Kay in Bulletin 11 as coal No. 7.

Concerning the rest of the McLeansboro section the data at hand do not warrant generalizations.

QUATERNARY SYSTEM

PLEISTOCENE SERIES

Glacial till.—Glacial till mantles almost the entire district except the comparatively small area of the stream valleys from which it has been removed by erosion. It consists of a mixture of clay and more or less decayed pebbles and bowlders of many kinds of rock. The till has a rather uniform thickness of about 15 feet. In general those parts of the county above an elevation of 400 feet are underlain by a greater or less thickness of till covered by fine yellow clay, or loess, which is reported to average about 10 feet thick, so that the surface covering is not uncommonly 25 to 35 feet thick. This thickness of glacial till is of no special moment in the exploitation of the coal beds.

Valley fill.—Those parts of the county lying below an elevation of 410 feet above sea level along the principal valleys are very likely to be underlain by a varying amount of silt and sand, not improbably water soaked. This alluvial material is in places as much as 120 feet thick. In places near the outcrop of coal No. 2 near Murphysboro the irregularities of the rock floor below the valley fill affect the thickness of the roof above the coal to an important extent. The mines of Big Muddy Coal and Iron Company near Big Muddy River have found that considerable care must be exercised in opening up new work to avoid weak or thin roof. For a discussion of the origin of the alluvium which has no special bearing upon the coal resources of the region, the reader is referred to the text of the Murphysboro-Herrin folio, where the subject is discussed in detail.

The following sections show the character of the surficial material near Murphysboro:

Section of surficial material in the SW. cor. SE. ¼ NE. ¼ sec. 4, T. 9 S., R. 2 W.

Description of strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Clay, yellow, sandy	18	..	18	..
Clay, gray	10	..	28	..
Clay, gray, sandy	1	..	29	..
Sand, yellow	6	..	35	..
Clay, blue, sandy	15	..	50	..

Section of surficial material in the SW. cor SE. ¼ NE. ¼ sec. 4, T. 9 S., R. 2 W.
Concluded

Description of strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Clay, red	16	..	66	..
Clay, gray, sandy	1	..	67	..
Clay, red	2	..	69	..
Clay, gray, sandy	15	..	84	..
Clay, brown, sandy	4	..	88	..
Clay, green, sandy	4	..	92	..
Sand, yellow, and gravel, mixed	5	6	97	6
Shale, yellow, sandy	..	6	98	..
Shale, gray	..	..	..	..

Section of surficial material 500 feet southeast of center of the SW. ¼ sec. 3, T. 9 S., R. 2 W.

Description of strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Clay, gray	15	..	15	..
Clay, yellow, sandy	2	..	17	..
Clay, blue, sandy	23	..	40	..
Sand and clay mixed	10	..	50	..
Quicksand	5	..	55	..
Clay, blue, sandy	5	..	60	..
Quicksand and gravel mixed	5	..	65	..
Clay, red	11	..	76	..
Quicksand	2	..	78	..
Clay, red, and sand mixed	8	..	86	..
Shale, blue, sandy	..	6	86	6
Sand, clay, and coal mixed	5	6	92	..
Shale, blue, sandy, with concretions	..	..	..	..

The thickness of the alluvium in various parts of the district along the principal valleys is shown in the following table:

TABLE 1—*Recorded thicknesses of the drift in various groups of drill holes along the principal valleys in Jackson County*

Township and sections		Thickness *Feet*
T. 7 S., R. 1 E.	3, 4, and 9	29 — 56
	15 and 20	28 — 55
	24, 27, and 28	31 — 64
	29, 30, and 32	15 — 46
T. 8 S., R. 2 E.	2	99
	7	4 — 16
	11 and 14	85 —121
	16, 21 and 22	79 —110
	26 and 27	43 — 68
	28, 29, 30, 32, and 33	10 — 95
	34 and 35	49 —114

T. 9 S., R. 2 E.	1, 2, and 3	21 — 90
	4, 5, 8, and 9	0 — 97
	10, 11, and 12	13 — 80
		?100

Structure

Method of showing structure

The term *structure* as used in geology commonly refers to the attitude or "lay" of the rock layers; that is, whether they are flat lying, inclined, folded, or broken by faults. Structure of this kind can be represented by photographs and sketches, by diagrammatic cross-sections and block drawings, but most accurately by means of structure contours. The use of structure contours to show differences in elevation or relief has been explained with considerable detail in preceding bulletins[5] of the series so that an explanation will not be necessary at this place.

The reference stratum used in delineating the structure shown on Plate I is the bottom of No. 2 or Murphysboro coal. In preceding bulletins the reference stratum has commonly been the surface of the coal bed used. The bottom rather than the top of the bed is used, since the seam is divided into two benches by a considerable thickness of intervening strata, and the lower bench rather than the upper is mined; it is believed, therefore, that a structure map based upon the lower bench will be more useful and more accurate than one based upon the upper bench.

The structure contours are represented on the map by the prominent irregularly curved red lines which cross the map in a general north-south direction. These lines show the position of coal No. 2 above sea level. Since in this area as in general throughout the Illinois coal basin the beds of the Pennsylvanian series are essentially parallel, the general geologic structure is indicated by the lines representing the elevation of the base of this bed.

Reliability of structure contours

The reliability of the structure contours is affected: (1) by the accuracy of the surface elevations; (2) by the variability of the calculated intervals between coal No. 6 and the base of coal No. 2; and (3) by the number and distribution of the points whose altitudes are known.

That part of the district lying within the Murphysboro and Herrin quadrangles contains accurately determined surface elevations. The reference strata are coal beds that have been extensively worked and whose depths below the surface have been noted in numerous shafts,

[5] Bulletins 10 and 11, Illinois Mining Investigations.

wells, and drill holes. At most such points the altitude of the surface was obtained by hand level or barometer from some of the numerous bench marks, and the determinations have involved short horizontal distances and small possibilities of error.

The variation of the interval between the two coal beds is more likely to lead to a mistake in determining the altitude of coal No. 2. In T. 7 S., R. 1 W., very few of the drill holes reached the lower coal, and at a few places in the township the contours are based upon the altitude of coal No. 6 by assuming the interval between the coals to be about 250 feet. In the northeast corner of the map of Jackson County, north and east of the outcrop of coal No. 6, are shown the contours based upon the surface of coal No. 6 for this same area. These connect with the contours shown on the maps of District VI and District VII.[6]

On account of the scarcity of outcrops drill holes and mines are the principal sources of information. These are fairly evenly distributed so that error arising from the scarcity of determined altitudes of recognizable strata is probably not great.

The dip of the coal in the mines also affords some information for working out the structure, though the assumption of a uniform dip between determined points may be a source of slight error. A few faults having a throw of 8 to 22 feet, local irregularities in dip, and low folds were found in some of the coal mines and in a few surface exposures. Local irregularities such as these do not appear in the structure contours on the geologic map.

Inasmuch as nearly all the drill holes and mines are located within the boundary of the Murphysboro and Herrin quadrangles, and as accurate elevations are lacking for the few localities outside the quadrangles, the structure is not shown beyond the limits of these areas.

USES OF THE STRUCTURE MAP

The primary purpose of the structure map (Plate I) is to show the structural features. The coal stratum slopes away or dips as shown by arrows from contour lines of higher elevation to those of lower.

In addition to the usefulness of the structure contour map in showing the lay of the coal, it can be used to determine the approximate depth of the coal bed. In case the depth of the coal is desired at some point crossed by a structure contour line, it can be readily calculated by subtracting the elevation shown on the contour line from the surface altitude. If the point lies between two contour lines, its relative distance from them is observed, and the elevation of the coal

[6]Bulletins 11 and 15, Illinois Coal Mining Investigations.

approximated accordingly, after which process the regular calculation can be made.

One of the special services of the coal structure map in Illinois has been to determine the possible areas of oil and gas accumulation. It has been found as a rule that structural features affecting the "Coal Measures" affect also the underlying rock to a considerable depth in the same way, though possibly to a greater or less degree. A relationship of areas of accumulation to anticlinal folds and domes is known to exist, and the fact that, at least in some places, domes in the coal strata indicate conditions favorable for oil and gas has given added value to structure contours on the coal beds.

STRUCTURE OF DISTRICT II

GENERAL FEATURES

The structure of District II is dominated by an uplift in the southwestern part which results in a general northeastern dip. The top of the Pottsville sandstone, for instance, which is 850 feet above sea level near Sand Ridge, drops to about 300 feet below in the northeastern corner of Jackson County. The average slope of the strata is 50 to 75 feet per mile, but in the hilly country the Pottsville sediments slope in places as much as 10 degrees, or 1 foot in 6. The area of greatest uplift is flanked on the east by steeply dipping strata and is terminated on the north by a fault of 100 to 200 feet throw. Coal No. 2 outcrops along the flanks of the anticline but does not rise over the crest, which is underlain by Pottsville sandstone. The coal continues for some distance farther west on the north side of the fault than on the south side.

DETAILS OF STRUCTURE

The general northeast dip of the coal is modified by more or less pronounced irregularities. The most important of these are: (1) a sharp anticline in the southeast quarter of T. 7 S., R. 1 W.; (2) an unsymmetrical broad anticline in the west side of townships lying in R. 3 W., extending south from near Ava to T. 9 S., R. 3 W.; (3) an east-west syncline at Sato; (4) an anticline lying just north of the syncline last mentioned and extending east, curving somewhat northward to the county line; (5) a broad, somewhat irregular syncline plunging northeastward and extending from the southwest corner of the district in T. 9 S., R. 3 W., to the syncline in T. 7 S., R. 1 W.; (6) the fault near the Perry County line. Of these irregularities only the first lies entirely within the area underlain by coal No. 2. The coal is more or less involved in the others. The various structural features are described in greater detail in the following paragraphs.

1. The anticline in T. 7 S., R. 1 W., is determined from elevations of the coal in three drill holes located in sections 26 and 27. A difference in elevation of coal No. 6 amounting to 150 feet is indicated by these three holes arranged in a linear manner in the north half of the two sections. It is not known whether this difference in elevation is due to faulting or to folding, and the projection of the crest of the anticline northward as a narrow structural ridge is conjectural. The more satisfactory delineation of this structure will have to wait for additional drilling along the supposed crest of the fold.

2. The broad anticline south of Ava for the most part lies west of the outcrop of coal No. 2 and therefore without the district, except that the coal in places rests well up on the flank of the anticline in uneroded outliers of little importance. Only that part of the anticline in which the coal is involved is shown on the structure map (Pl. I). The full details of the structure to the west appear in the Murphysboro-Herrin folio, to which the reader is referred.

3. The syncline extending east from near Sato is little else than a low place in the crest of the general anticline described under (1). At the position of this syncline the coal extends more nearly across the anticline than elsewhere, a small area of coal existing on the west flank of the anticline near Ava. As the bed outcrops rather extensively, it is exploited by numerous drift mines.

4. The anticline north of Sato extends eastward into the coal field to the Illinois Central Railroad, and possibly as far as Elkville, where drilling indicates the presence of a slight terrace interrupting the general eastward dip of the strata. As drilling north of Vergennes is very meager, the delineation of this structural feature is left indefinite, being indicated by broken lines. An oil prospect sunk on what is thought to be the crest of the fold was unsuccessful.

5. The syncline plunging northeast from the southwest corner of the district is part of the general northeastward dip of the coal basin along its southwestern margin and culminates in the trough which lies between Elkville and the anticline in the southeast quarter of T. 7 S., R. 1 W. This trough is the southern continuation of a wider basin lying east of the Duquoin anticline in Franklin, Perry, and Jefferson counties.

6. The most conspicuous structural feature of the district, as presented in the map, is the fault extending in an east-west direction near the Perry County line. This displacement, amounting to 100 to 200 feet, has been traced for a distance of at least 4 miles west from the outcrop of coal No. 2 south of the fault. North of the fault line

the coal is believed to be present in a narrow strip in Jackson County extending northward into Perry County, although there has been no drilling in that strip and the westward extension of the coal has not been determined. The extension of the fault line eastward from the outcrop is obscured by valley fill and glacial till. It is possible that it may be a continuation of the faulted area which traverses Williamson and Franklin counties in a direction running slightly north of west, possibly entering Jackson County due west of Hallidayboro. If this faulted zone persists through Jackson County, it will account for the considerable differences in elevation of the coal noted in the southeast quarter of T. 7 S., R. 1 W., and interpreted above for want of better evidence as being due to folding. So far as known, the mine at Hallidayboro has not encountered faulting.

Figures 3 and 4 show the structure and position of the coal along east-west and north-south lines in Jackson County.

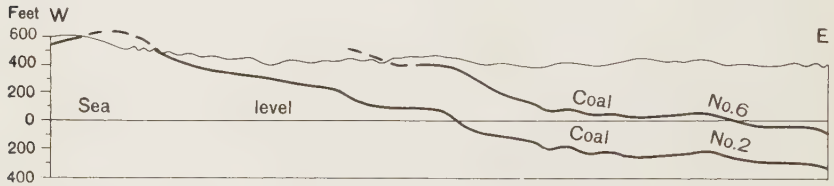


Fig. 3.—East-west section across the part of the Murphysboro and Herrin quadrangles in Jackson County.

Fig. 4.—North-south section across the fault in Jackson County.

CHAPTER IV—ECONOMIC GEOLOGY OF THE COALS

Pottsville Coals

The following is the description given by Shaw and Savage:[1]

The coals of the Pottsville formation are relatively unimportant. A short distance above the middle of the formation is a lenticular bed of coal, which locally attains a thickness of 2 feet, but which is absent from a considerable part of the area. One of the best exposures of this bed is in the bank of a small stream in the SE. ¼ sec. 8, T. 8 S., R. 3 W., where 20 inches of good short-grained coal may be seen. The next coal is about 75 feet higher and is nowhere more than 1 foot thick.

The only Pottsville coal so far worked, locally known as the Pocket coal, lies 50 to 70 feet below the top of the formation. It is of Mercer age and is probably contemporaneous with the variable and lenticular beds that in other portions of the State have been called coal No. 1. This bed has been opened near the middle of the SW. ¼ sec. 7, T. 9 S., R. 2 W., where it is of excellent quality and about 3 feet thick. The bed is also found in the NW. ¼ sec. 18, T. 8 S., R. 3 W., but is there pockety and scarcely workable at present.

Carbondale Coals

COAL NO. 2

DISTRIBUTION AND THICKNESS

The lowest coal bed of the Carbondale formation is No. 2 (Murphysboro) coal. The Murphysboro coal is probably identical with the bed mined at La Salle known as the "Third Vein", and with the coal mined at Colchester. The coal is thought to be absent or at least not of workable thickness in the eastern part of the district, but is almost continuously workable along the foot of the hilly country near and north of Murphysboro. In the vicinity of Murphysboro it is divided into two beds, each of which has been mined extensively. It has also been mined one and a half miles northwest of Oraville, at Bryden, at Sato, and at points one and a half miles south of Ava, and two miles northeast of Sato.

The thickness of coal No. 2 is exceedingly variable, largely because the vein is commonly split, but also because of a gradual thinning toward the east. Numerous observations of the thickness of the bed have been entered in Table 2. Drillings are more numerous in T. 8 S., R. 1 W. than in other townships. Where the bed is split the upper seam commonly varies from 24 to 45 inches in thickness, and the lower bed from 30 to 48 inches, being slightly thicker than the upper bench. Where only one bench is recorded in the drill record it commonly ranges, in the district as a whole, from 47 to 88 inches in thickness.

[1]Shaw, E. W., and Savage, T. E., U. S. Geol. Survey Geol. Atlas, Murphysboro-Herrin folio (No. 185), p. 13, 1912.

TABLE 2.—*Thicknesses of coal No. 2 in District II (Jackson County)*

Thickness in inches		0–5	12	14	15	17	18	19	22	24	25	26	27	28	29	30	31	32	33	36	37	38	39	40	41	42	44	45
T. 7 S. R. 1 & 2 W.	Upper bench	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Lower bench	..	1	..	..	..	1	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	One bed	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
T. 8 S. R. 1 W.	Upper bench	..	..	1	1	..	..	..	..	2	..	1	2	2	1	3	2	..	1	2	..	..	..	..	1	1	..	1
	Lower bench	3	..	..	..	..	..	..	..	1	..	..	..	..	..	2	..	1	..	1	..	1	..	2	..	1	..	1
	One bed	..	..	..	..	..	..	..	..	..	..	..	..	1	..	2	..	..	..	1	2	..	..	..	..	..	..	..
T. 8 S. R. 2 W.	Upper bench	..	..	..	..	1	..	..	..	..	1	..	..	..	..	1	..	..	..	4	..	..	..	..	..	..	..	1
	Lower bench	1	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..
	One bed	..	..	..	..	..	..	1	2	..	..	..	..	1	..	..	..	..	1	3	..	..	..	..	..	..	..	..

TABLE 2—*Thicknesses of coal No. 2 in District II (Jackson County)*—Concluded

Thickness in inches		46	47	48	52	53	54	56	57	63	65	66	67	69	70	71	72	73	75	76	77	79	80	81	83	84	87	88
T. 7 S. R. 1 & 2 W.	Upper bench	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Lower bench	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	One bed	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
T. 8 S. R. 1 W.	Upper bench	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Lower bench	1	2	2	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	One bed	..	1	..	1	1	..	1	..	..	2	2	1	1	..	2	1	..	..	1	2	..	..	..	..	..	..	..
T. 8 S. R. 2 W.	Upper bench	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
	Lower bench	..	..	..	..	..	..	1	..	..	..	1	..	..	1	..	..	..	..	..	..	1	..	..	..	..	..	..
	One bed	..	..	1	..	..	1	..	..	..	..	2	..	1	2	1	5	..	..	2	..	..	1	1	1	3	1	2

Attention has already been directed to the restricted distribution of the thick, undivided Murphysboro coal. Although without much question one or more coal beds continuous with part or parts of the Murphysboro coal underlie all of District II and are correlated from drill hole to drill hole as coal No. 2, the area of coal workable at present, at least, is small. There is an already nearly exhausted area of thick coal near Murphysboro and a less fully known area along the outcrop northeast of Sato where it is being mined at a country bank. The location of the commercial mines at Murphysboro (see Plate I) is determined by the area of thick coal and fairly well indicates its outline. Mine workings extend as far east and north as conditions will allow; shale partings finally become too numerous or too thick to handle. To the west and south the minable area extends to the outcrop, or until the roof becomes unsatisfactory. There is some tendency also for the bed to split up along the southwest margin of the district. It is probable that the original area of thick coal near Murphysboro did not exceed 15 square miles and that two-thirds or more of that coal has been mined or rendered unminable.

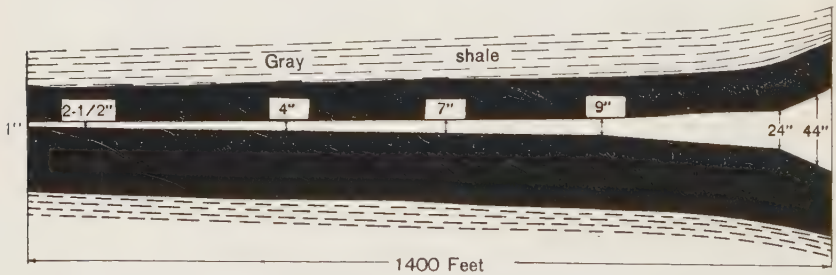


FIG. 5.—Diagrammatic illustration showing the thickening of the parting in the Harrison mine, Big Muddy Coal and Iron Co., west rib of 9th north, west. Bearing of entry, N. 41° E.

PHYSICAL CHARACTERISTICS

The coal has a bright luster, contains bands of dull and glance coal and mother coal, breaks with a hackly fracture into blocks, is somewhat harder than the upper coals, contains little hygroscopic water, and withstands considerable exposure without slacking. The bed commonly contains a few sulphur balls and bands which are discarded by the miner.

The clay which commonly separates coal No. 2 into two benches is of variable thickness. In one mine the parting varies from 18 inches to 35 feet and in other mines may be entirely absent in some places or as much as 3 or 4 feet thick in others. The greatest interval between the two benches as recorded in the drill records is 43 feet 6 inches.

The accompanying drawing (fig. 5) sketched in the Harrison shaft, Big Muddy Coal and Iron Company, illustrates the variations in thickness of the parting within a distance of about a quarter of a mile.

The parting is commonly gray shale, thin bedded, and filled with plant impressions and may appear at various positions in the seam. In places it becomes very carbonaceous and is likely to become more carbonaceous near the base than at the top. Bone coal serves as the parting locally. The sections of the coal given in the following pages include comments on the parting, as observed in the mines.

DETAILED OBSERVATIONS

Following are a number of detailed observations of the coal made in several of the mines of the district by members of the Investigations or of the State or Federal Surveys.

GUS BLAIR BIG MUDDY COAL CO., MINE NO. 2

General description.—Maximum thickness of the upper bed, 36 inches; minimum, 24 inches; average, 30 inches. Maximum thickness of lower bed, 48 inches; minimum, 32 inches; average, 42 inches. The shale parting varies from 18 inches to 25 feet in thickness and is present throughout the mine. The bed contains a little bone coal at the bottom. Over part of the mine both benches are worked, elsewhere only the lower bench. Where only the lower bench is worked the parting serves as roof where it is thick enough, but where it is too thin the upper coal forms the roof. No attention is paid to the cleat, though it is recognized that the coal works easier if worked on the face.

Section, face of room on third northeast entry.—Thickness of upper bench 2+ feet. Coal harder, more porous than the lower coal; contains numerous lenses of mother coal. The parting has a thickness of 2 feet. The upper 1½ feet is gray shale, thin bedded and filled with plant impressions. The lower 6 inches is shale with coal in thin bands. The lower bench of coal is 3½ feet thick. The upper 6 inches is laminated, dull, and glance coal. The middle two feet of coal is very uniform in character. There are few or no bands of glance coal; in the lower foot of the bed the coal is soft, bright, with bands of coal separated by layers of mother coal, giving a laminated appearance. There is a little bone coal at the bottom of the bed. The cleat is strongly developed—face N. 35° W., butt N. 38° E. Some calcite occurs along the cleavage faces.

This section is reproduced graphically in figure 6, No. 1.

BIG MUDDY COAL AND IRON CO., MINE NO. 9

Section 1.—Top coal has a thickness of 24 inches; harder than the bottom coal; cleat planes cut the coal into small blocks making much fine coal. Calcite occurs along the cleavage planes. Coal much laminated and has partings of mother coal. The parting or the shale between the two benches is only a knife-edge in thickness. The lower coal is 44 inches thick.

For a graphic reproduction of this section see figure 6, No. 2.

Section 2.—Top coal has a thickness of 22 inches and contains layers of glance coal separated by bands of mother coal. The parting is of knife-edge

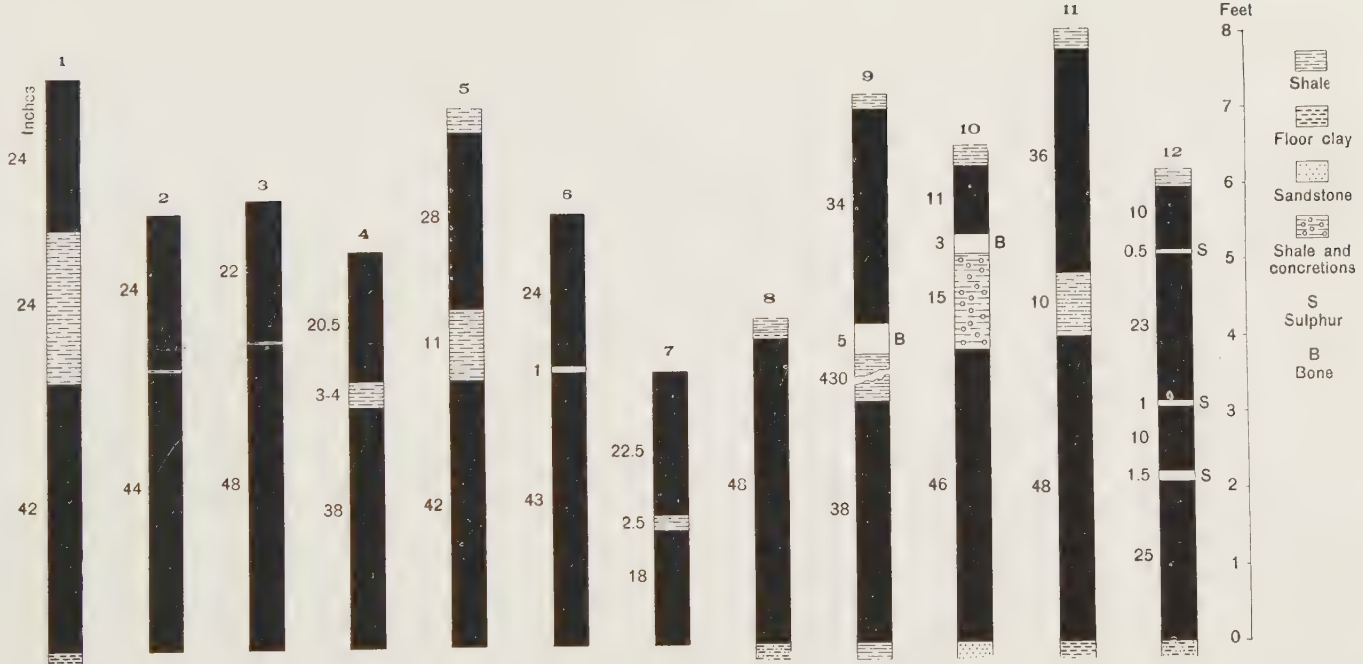


FIG. 6.—Graphic sections of coal No. 2 in Jackson County: (thickness in inches).

1. Gus Blair Big Muddy Coal Co., mine No. 2, room on 3d NE. entry.
2. Big Muddy Coal & Iron Co., mine No. 9.
3. Big Muddy Coal & Iron Co., mine No. 9.
4. Big Muddy Coal & Iron Co., Harrison mine, room 14, NW. entry.
5. Big Muddy Coal & Iron Co., Harrison mine, room 87, off 4th NW. entry.
6. Big Muddy Coal & Iron Co., Harrison mine, room 7, off 7th NE. entry.
7. Big Muddy Coal & Iron Co., Harrison mine, 1st NW. entry.
8. J. B. Schimpf mine, NE. ¼ sec. 11, T. 7 S., R. 3 W.
9. Drill hole, SW ¼ sec. 32, T. 8 S., R. 2 W.
10. Gus Blair Big Muddy Coal Co., mine No. 1, Murphysboro.
11. Cairo Ice & Coal Co. mine, Bryden.
12. Woods slope, Carbondale.

thickness. The lower coal has a thickness of 48 inches and is more blocky than top coal. The bottom of the lower bed commonly contains bone coal; near the outcrop this becomes 8 inches thick.

For a graphic reproduction of this section see figure 6, No. 3.

Cleat.—Several measurements of the cleavages have been made in this mine as follows; the first column gives directions of the better cleavage.

Main haulage road 1,000 feet from shaft	N. 35° W.	N. 32° E.
Room 5, 3d south, 8th east	N. 32° W.	N. 30° E.
Room 4, 6th north, 5th east	N. 28° W.	N. 20° E.

On the main south entry two partings of gray shale are found in the coal—one a 3-inch parting 6 inches from the bottom, and the other a 4-inch parting 18 inches from the bottom.

BIG MUDDY COAL AND IRON CO., HARRISON MINE

Section 1, face, 14th northwest entry.—The upper bench has a thickness of 20½ inches; coal is fairly bright, has considerable mother coal scattered through it in lenses and partings; the cleat cuts the coal into small blocks. The parting is very carbonaceous shale with coal streaks scattered through it, having a thickness of 3 to 4 inches. The lower bench has a thickness of 38 inches; it is bright, hard, blocky; contains a few balls of sulphur; has partings of mother coal between glance and dull coal; the lower 2 inches has partings of bone coal. This section is shown graphically as No. 4 in figure 6.

Section 2, room 87 off the 4th northwest entry.—The top coal has a thickness of 28 inches; coal more blocky than in section above; somewhat laminated with mother coal in partings and lenses; glance coal is scattered through in bands. The parting is gray shale with only few plant impressions; thickness 11 inches. The bottom coal has a thickness of 42 inches; is harder than the top coal; more blocky; cleavage planes well developed; glance coal in bands is scattered through the bed. The coal contains a few sulphur balls. For a graphic reproduction of this section see figure 6, No. 5.

Section 3, room 7, off the 7th northeast entry.—Top coal has thickness of 24 inches; coal more blocky than usual in the mine; has bright, banded appearance; contains a small amount of calcite; there are numerous lenses and bands of mother coal; a few streaks of bone coal occur in the upper 2 inches of the bed. The parting is bone coal 1 inch thick. The bottom coal has thickness of 43 inches; blocky bright and dull coal with bands of bright coal scattered through it; a small amount of mother coal present; bottom 2 inches of the bed is bony and filled with calcite plates along the cleavage planes. For a graphic reproduction of this section see figure 6, No. 6.

Section 4, 1st northwest entry.—Top coal has thickness 22½ inches; coal has a bright, banded appearance; contains lenses and layers of mother coal; 3 inches of bone coal occur in the top of the bed; there is a little sulphur. The parting is 2½ inches thick; soft clay, bluish gray, with varying amounts of carbonaceous matter. The bottom coal is 18 inches thick; bright coal, with a large amount of glance coal present in bands; very little mother coal and no sulphur; bottom coal hardest as elsewhere over the mine. This section is reproduced graphically as No. 7 figure 12.

TABLE 3.—*Thicknesses of Coal No. 2 and character of roof and floor in mines of District II (Jackson County)*

Company	ROOF											FLOOR	
	Cap Rock			Immediate Roof			Draw Slate						
	Character	Thickness	Height above Coal	Character	Thickness	Contact with Coal	Character	Thickness	Contact	Persistence			
Big Muddy C. & I. Co. No. 9	gr sh	12′-18′	- - -	top coal	8″	------	lam sh	2″-4′ aver 1′	--	- -			
Do No. 9	gr sh	20′±	- - -	bk sl and bonecoal; coal	6″ / 12″	- - -	-- --	----	- - -	- -			
Do No. 9	- - -	- -	- - -	gr sl	31′	------	------	- - -	-- -	- - -			
Do Harrison	- ---	- --	- -	sh	60′-70′	yes	carb sh	2″-6″ —	- -	- - -			
Gus Blair—No. 2	hd sl	18′-30′	contact	top coal / sh ptg	2′-3′ / 18″-25′	yes	none	-- -	--- -	-- -			
James Bush	bk sh (sl)	--- -	- -	hd sdy sh	2′	------	clod	2″	- -	- - -			
Cairo Ice & Coal Co.	--	- - -	- -	ss	9′-11′	- - -	--- --	-- -	- --	-			
Wm. Campbell	-- -	-	- ---	sh and ss	- -	- - -	sheepskin	1/2″	- --	- -			
Gartside No. 3	-- -	- -	- -	-	- -	- --	-----	--- -	-- --	- - -			
Do No. 3		- - -	- -	sh	- - ---	- --	-- --	- -	- ---	- - -			
Do. No. 4	- --	- --	- -	- -	------	------	------	2″-4″	smooth	local			
Nesbit & Wilson	ss	-	- -	sh or ss	sh 3′ or less	- --	sheepskin	2″-6″	--- --	general			
J. B. Schimpf	--- -	- -	- - -	sh and ss	- -	-	do	2″	--- --	- - -			
J. B. Woods	bk sh	- - -	- -	sdy sh	2″+	------	------	-- -	- --	- - -			

TABLE 3.—*Thicknesses of Coal No. 2 and character of roof and floor in mines of District II (Jackson County)*

Concluded

Company	COAL BED								FLOOR			
	Thickness of Top Bed			Thickness of Lower Bed			Parting		Bedded impurities	Character	Thickness	Variations
	Max.	Min.	Aver.	Max.	Min.	Aver.	Character	Thickness				
	inches	*inches*	*inches*	*inches*	*inches*	*inches*						
Big Muddy C. & I. Co. No. 9	------	------	24	------	------	------	------	------	sh to bone ptg	ss	5′+	constant
Do No. 9	84	56	72	------	------	------	------	------	sh ptgs in lower part	cly hd sl coarse	------	------
Do No. 9	------	28	------	------	49	------	------	thin	do	fc	2′-6″	------
Do Harrison	28	20	------	------	------	42	sh	1″-4′+	------	sdy cl and ss	6″-6′	constant
Gus Blair—No. 2	36	24	30	48	32	42	sh	18″-25′	bone in bottom	cl hd sh	2″	------
James Bush	------	------	70	------	------	------	------	------	------	sdy hd fc	------	over mine
Cairo Ice & Coal Co.	------	36	------	------	------	48	sh	10″	------	sft fc	------	------
Wm. Campbell	45	36	42	------	------	------	------	------	------	sh and ss	------	------
Gartside No. 3	------	36	------	------	------	47	------	25″	------	------	------	------
Do No. 3	------	------	------	54	24	48	sh	12″-35″	------	------	------	------
Do. No. 4	------	------	36	------	------	48	sh	0-20′	ptg and s bands bone coal	gr sh	3″-4′ ss below	------
Nesbit & Wilson	80	50	65	------	------	------	------	------	------	hd ss	------	------
J. B. Schimpf	64	42	48	------	------	------	------	------	------	soapstone	------	------
J. B. Woods	84	60	70	------	------	------	------	------	------	hd sdy fc	------	------

Abbreviations interpreted: hd, hard; gr, grey; bk, black; cl, clay; cly, clayey; fc, fire clay; sl, slate; sh, shale; ss, sandstone; sdy, sandy; ls, limestone; ptg, parting; lam, laminated; s, sulphur.

TABLE 4.—*Analyses of mine samples of coal from District II (Jackson County)*
(Not exactly indicative of commercial output)

Lab. No.	Co-op. No.	Date 1912	County	Coal bed	Proximate analysis of coal 1st: "As recd," with total moisture. 2d: "Dry" or moisture free				Sulphur	CO_2	B. t. u.	Unit coal
					Moisture	Volatile matter	Fixed carbon	Ash				
5225	14	7-12	Jackson-----	2	7.72	35.09	48.56	8.63	2.01	.29	12248	-----
					Dry	38.02	52.62	9.36	2.18	.31	13272	14839
5226	14	7-12	Jackson-----	2	8.77	32.78	50.58	7.87	2.00	.02	12253	-----
					Dry	35.93	55.44	8.63	2.19	.03	13430	14885
5228	14	7-12	Jackson-----	2	9.18	34.70	51.58	4.54	.60	.05	12752	-----
					Dry	38.20	56.80	5.00	.66	.03	14040	14867
5248	13	7-12	Jackson-----	2	9.88	33.23	52.43	4.46	.70	.33	12709	-----
					Dry	36.87	58.18	4.95	.77	.36	14103	14926
5249	13	7-12	Jackson-----	2	10.91	33.51	51.20	4.38	1.14	.20	12503	-----
					Dry	37.61	57.47	4.92	1.28	.23	14034	14863
5250	13	7-12	Jackson-----	2	9.76	33.45	52.07	4.72	1.03	.51	12629	-----
					Dry	37.06	57.71	5.23	1.20	.56	13996	14874
5251	12	7-12	Jackson-----	2	9.51	33.13	52.12	5.24	.66	.94	12500	-----
					Dry	36.62	57.59	5.79	.73	1.03	13814	14758
5252	12	7-12	Jackson-----	2	9.37	33.39	49.29	7.95	2.11	.94	11972	-----
					Dry	36.48	54.38	8.78	2.32	1.03	13208	14671
5253	12	7-12	Jackson-----	2	9.99	32.51	51.88	5.62	.62	.20	12308	-----
					Dry	36.12	57.63	6.25	.69	.22	13673	14686
5496	16	8-12	Jackson-----	2	9.25	34.67	50.53	5.55	1.41	.13	12528	-----
					Dry	38.20	55.68	6.12	1.56	.14	13804	14834
5497	16	8-12	Jackson-----	2	9.56	34.52	50.47	5.45	1.32	.27	12483	-----
					Dry	38.16	55.83	6.01	1.46	.30	13781	14811
5498	16	8-12	Jackson-----	2	9.20	34.48	50.54	5.78	1.44	.19	12481	-----
					Dry	37.97	55.66	6.37	1.59	.21	13746	14814
5286	15	8-12	Jackson-----	2	8.32	35.28	51.10	5.30	1.39	.19	12671	-----
					Dry	38.49	55.74	5.77	1.53	.21	13822	14791
5287	15	8-12	Jackson-----	2	8.86	35.00	49.74	6.40	1.69	.07	12436	-----
					Dry	38.40	54.57	7.03	1.85	.08	13645	14830
5288	15	8-12	Jackson-----	2	8.91	34.03	53.17	3.89	1.15	.07	12844	-----
					Dry	37.36	58.37	4.27	1.26	.08	14101	14823
4773	55	4-12	Jackson-----	6	10.88	31.71	48.90	8.51	.65	.30	11594	-----
					Dry	35.57	54.88	9.55	.73	.34	13009	14531
4780	55	4-12	Jackson-----	6	7.17	36.36	45.25	11.22	3.92	.43	11678	-----
					Dry	39.18	48.74	12.08	4.22	.47	12581	14617
4784	55	4-12	Jackson-----	6	8.82	35.30	44.96	10.92	3.46	.50	11547	-----
					Dry	38.72	49.30	11.98	3.79	.54	12663	14676

TABLE 5.—*Average analyses of Illinois coals by districts*

(Figures are for coal as received)

Analyses by J. M. Lindgren under general supervision of Prof. S. W. Parr

District	Coal bed	Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	B. T. U.	Number of samples averaged
La Salle	2	16.18	38.83	37.89	7.08	2.89	10981	33 from 11 mines
Murphysboro	**2**	**9.23**	**33.98**	**51.02**	**5.72**	**1.29**	**12488**	**15 from 5 mines**
Rock Island and Mercer counties	1	13.46	38.16	39.75	8.63	3.59	11036	14 from 4 mines
Springfield-Peoria	5	15.10	36.79	37.59	10.53	3.52	10514	54 from 17 mines
Saline County	5	6.75	35.49	48.72	9.04	2.92	12276	27 from 7 mines
Franklin and Williamson counties	6	9.21	34.00	48.08	8.71	1.53	11825	58 from 16 mines
S. W. Illinois west of Duquoin anticline	6	12.56	38.05	39.06	10.33	4.01	10847	76 from 25 mines
Danville: Grape Creek coal	6	14.45	38.29	38.75	9.98	2.93	11143	18 from 2 mines
Danville: Danville coal	7	12.99	38.29	38.75	9.98	2.93	11143	18 from 2 mines

Cleat.—The following measurements of the direction of the cleavages have been made; the first column gives the directions of the better cleavage:

Room 10, 13th northwest entry	N. 20° E.	N. 43° W.
Face, 14th northwest entry	.....	N. 43° W.
1st northwest entry	N. 32° E.	N. 35° W.
Room 7, 7th northeast entry	N. 20° E.	.....

These measurements and others made during the last few years by various members of the Survey are shown in tabular form in Table 3.

Several additional graphic sections based upon these measurements and upon drill records are also shown in figure 6.

QUALITY OF COAL NO. 2

Three samples from different parts of each of 5 mines have been collected by members of the Investigations, and analyses made under the direction of Prof. S. W. Parr. These analyses have recently been published in Bulletin 29 of the State Geological Survey and are reproduced below in Table 4.

The comparative quality of the coal is illustrated by the analyses presented in Table 5 and the graphic presentation of the analyses in Plate III.

The analyses make apparent immediately the reason for superiority of the No. 2 (Murphysboro) coal. The percentage of fixed carbon is higher than in the other coals of the State, and the percentages of ash, moisture, and volatile matter are correspondingly lower.

ROOF OF COAL NO. 2

The roof of coal No. 2 in some places is the gray shale above the undivided bed; in some places the upper bench of the divided bed; and in still other places, the parting between the two parts of the divided bed. The gray shale above the bed is a slabby thin-bedded shale of varying shades of gray depending upon the amount of carbonaceous material present. It generally falls in thin sheets. The character of the roof of coal No. 2 in the various mines of the districts is shown in Table 3.

Not uncommonly between the coal and the gray shale is a few inches of draw slate which may be 4 feet thick in some places. Usually it is less than a foot thick, and in one mine 2 to 6 inches. The draw slate differs from the gray shale above in being more laminated and carbonaceous. Between the dark slate and the gray shale is commonly a thin layer of soft structureless clay resembling floor clay and known locally as "sheepskin". In No. 9 mine this clay seems to mark the top of the coal and black slate section, the slate appearing in more or less lenticular masses below, and in places it truncates the bedding of the slate.

The roof shale of coal No. 2 is the most valuable and accessible shale in the district. Near Murphysboro the shale forms an almost unbroken mass nearly 100 feet thick with a thin coal near the top, overlain farther north by a heavy sandstone. That part of the shale that overlies a thin coal about 100 feet above No. 2 coal is being extensively mined by the Murphysboro Paving Brick Company at Murphysboro (fig. 7). The same bed outcrops near De Soto and elsewhere in the southern part of Herrin quadrangle and might be successfully worked at a number of places. It outcrops in a strip varying in width from a few feet to 2 miles and extends east from Murphysboro toward Carbondale, and north from Murphysboro to the northwest corner of Vergennes Township where it is faulted down to some distance below the surface. Most of the outcrop lies near a railroad.

FIG. 7.—Shale in the pit of the Murphysboro Paving Brick Co. (Photo by F. H. Kay.)

FLOOR OF COAL NO. 2

Underlying coal No. 2 is commonly a bluish-gray sandstone, the thickness of which usually exceeds 5 feet. In places there is a layer of clay, commonly called "fire clay", between the coal and the sandstone. This may reach 4 or 5 feet in thickness and may contain streaks of coal and carbonaceous material. In some of the mines where this underclay occurs it has not been penetrated, but as the clay under the coal in the drill holes rarely exceeds 10 feet, it probably is generally of no great thickness. So far as is known, the clay offers no difficulty in mining the coal.

STRUCTURAL IRREGULARITIES

At least three kinds of structural irregularities of some importance are found in coal No. 2. These are faults or "slips", "horsebacks", and "rolls". These phenomena are like similar irregularities found in other coal beds of the State in greater or less frequency. It is not uncommon to find all three irregularities associated (fig. 8), but the horseback is a very common accompaniment of the slip (fig. 9).

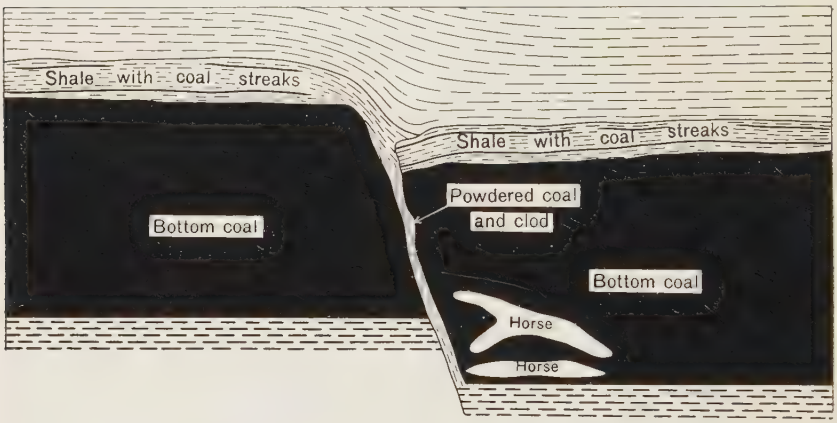


FIG. 8.—Diagrammatic illustration of a fault, slip, and horseback in mine No. 2, Gus Blair Big Muddy Coal Co.

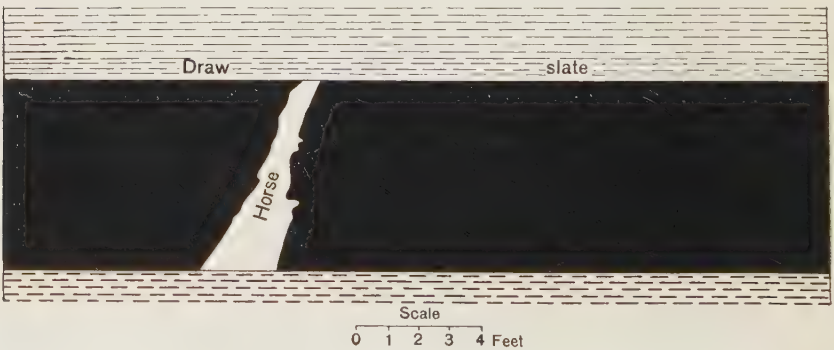


FIG. 9.—Diagrammatic illustration of a horseback in mine No. 9, Big Muddy Coal and Iron Co.

The faults or slips are slight displacements of the coal bed, the coal being offset along a fault plane. The slip plane not uncommonly terminates or appears to terminate a short distance above the coal, the overlying shale not being affected by the movement for more than the lower few inches. It seems apparent that in many places the fault-

ing is confined to, and due to, adjustments within the coal bed itself and not to major movements involving the entire field.

The miners' horse is commonly a clay or sandstone filling along a slip or fracture across the coal bed. These fractures may be accompanied by displacement and thereby become faults in the geological sense, or the bed may apparently have been pulled apart along the line of the slip without any displacement (figs. 9 and 10).

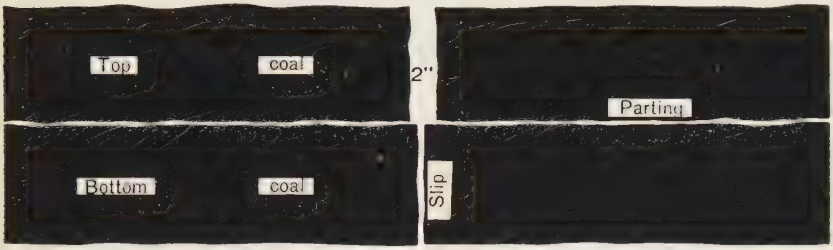


FIG. 10.—Diagrammatic illustration of a slip without displacement in mine No. 9, Big Muddy Coal and Iron Co.

Any considerable body of shale embedded in the bed of coal is also spoken of by the miners as a "horse". The "horse" shown in figure 11

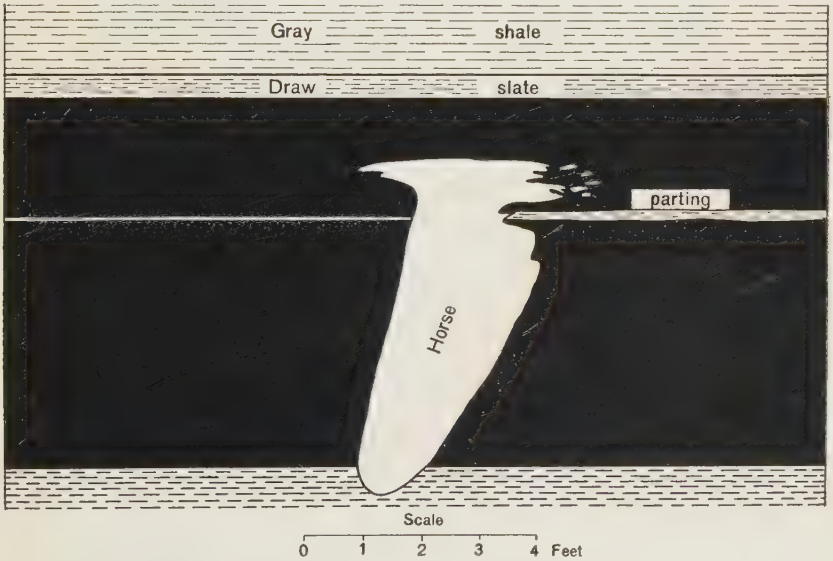


FIG. 11.—Diagrammatic illustration of a horse in Harrison mine, Big Muddy Coal and Iron Co.

has been traced for 1,000 feet in the Harrison mine of the Big Muddy Coal and Iron Company and still continues. The material forming the

"horse" is a hard, bluish-gray, micaceous sandstone, which fingers laterally into the coal and contains within it patches of coal or carbonaceous material. It is not improbable that the sandstone was deposited contemporaneously with the coal, or at least before the entire bed was deposited, since the upper part of the bed continues across the sandstone filling.

Rolls are interruptions in the continuity of the bed whereby the roof shale extends appreciably below the top of the bed usually along a narrow area (fig. 12). Apparently they represent depressions in the

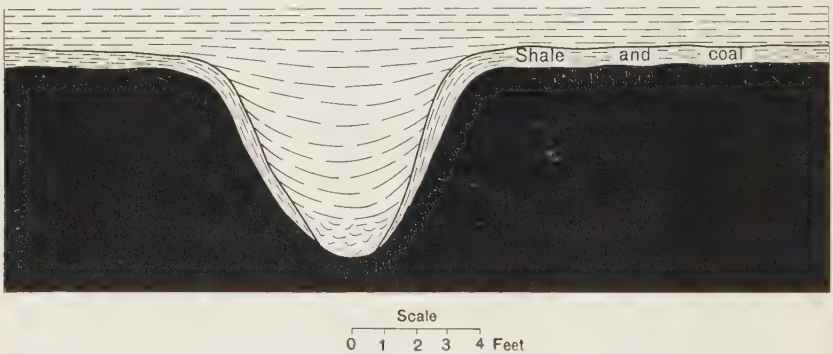


FIG. 12.—Diagrammatic illustration of a roll in mine No. 9, Big Muddy Coal and Iron Co.

top of the coal at the time of deposition of the shale, or places along which the bed has suffered an unusual amount of shrinkage. The clay occupying the roll is commonly slickensided and filled with minute cracks indicating that movement has taken place. The not uncommon continuity of the upper bed of shale and coal across or nearly across the coal bed, as shown in figure 12, seems to indicate that originally the surface of the coal extended about level across the position of the roll, and that the difference in the thickness of the bed has resulted, subsequently, possibly from unequal shrinkage. The width of these rolls is commonly not great; a width less than 10 feet is probably more common than greater widths. The extension of the rolls is known to be much greater than the width, but no data are available as to the actual length of any of them.

The irregularities in the bed described in the preceding paragraph are not sufficiently frequent to be a considerable hindrance in mining. Where they occur there is commonly difficulty in holding the roof, and horses frequently need to be blasted out where the punching machines are unable to cut through them. Mining is somewhat hampered in certain districts by insecure roof condition, especially where the mine

lies below a considerable thickness of valley fill previously described, and the thickness of shale above the coal is not great. These conditions are encountered especially where the mines are located on the terraces or river flats below elevations of 400 feet above sea level, and in those mines near the outcrop. In mine No. 2, Gus Blair Big Muddy Coal Co., the valley fill extends through the coal on the east side of the mine, so that bed evidently outcropped on the sides of the pre-glacial valley. As the material filling the pre-glacial valleys is in many places fine sand saturated with water, the roof becomes very insecure where the shale separating the coal from the sand is thin. Surface subsidence, moreover, is relatively rapid above areas of quicksand that have been undermined. In general, because of the nearness of large bodies of underground water to the coal bed, especially in the vicinity of Murphysboro, the mines in this field have greater difficulty with water than most of those in other districts of the State.

COKING OF COAL NO. 2

A coke of fair grade has been made from the Murphysboro coal across the river south of Murphysboro. A few years ago several dozen ovens were in operation, but at present no coke is being produced in the district.

COALS BETWEEN COAL NO. 2 AND COAL NO. 6

COAL NO. 5

Of the coal beds between coal No. 2 and coal No. 6, none has been exploited in District II. Of these coals the thickest is No. 5 (Harrisburg coal), which lies between 20 and 50 feet below No. 6 (Herrin coal). The area underlain by this bed is slightly greater than that underlain by the upper coal, since it outcrops about three-fourths of a mile south of the outcrop of coal No. 6. The thickness of the coal is very uniform over large areas, averaging 4 feet 7 inches for 20 drill holes. The available data in regard to the thickness of the seam have already been summarized in Chapter III.

This coal has been extensively exploited in District V in Saline and Gallatin counties, and is known to be of excellent quality. The conditions for mining are favorable. The underclay is hard and does not creep readily. Above the coal is a bed of black shale which stands well as roof with little or no timbering. In many places in the lower part of the roof shale pyritic concretions or niggerheads are abundant. For further description of this coal in southern Illinois the reader may wish to refer to the forthcoming bulletin on District V. In Jackson County coal No. 5 is known only from drilling. Although

FIG. 13.—Graphic sections of coal No. 6 in Jackson County:

1. Peacock Coal Co., NE. ¼ sec. 17, T. 8 S., R. 1 W.
2. Chicago and Carbondale Coal Co., NE. ¼ sec. 8, T. 8 S., R. 1 W.
3. Hole No. 19, sec. 3, T. 7 S., R. 1 W.
4. Hole No. 32, NE. ¼ NE. ¼ sec. 26, T. 7 S., R. 1 W.

it never has been worked in this district, it could probably be mined in connection with coal No. 6 above without sinking separate shafts.

MINOR COAL BEDS

The two coal beds—the upper one about 24 inches in thickness and the lower one commonly thinner, but locally as thick, both of which are found rather generally between coal No. 5 and coal No. 2—are at present, at least, of no commercial importance. It is possible that the upper one of these beds will some time be sufficiently valuable to mine. Both beds are covered by dark shale, so that the roof conditions are apparently not unfavorable. (These two beds are not considered as coal resources in the present report.)

COAL NO. 6

The line of outcrop of No. 6 (Herrin) coal is shown on the map. East of this line the bed is probably everywhere present in this district and extends eastward underlying District VI and much of District V, and northward underlying the large area of the State included in District VII. In Districts VI and VII it is the principal coal bed mined, and the details of structure and physical characteristics of the coal have been discussed at length in Bulletins 11 and 15 covering these areas, to which the reader is referred.

Coal No. 6 is mined at a number of places along the line of the Illinois Central Railroad in the eastern part of the district. The coal is uniformly thick, averaging about 9 feet 6 inches. A "blue band" or dirt band, found almost everywhere 18 to 30 inches above the floor, consists generally of bone and shale. In general its thickness varies from ½ to 2½ inches, with an average of about 1 2/3 inches. In Jackson County a number of the drilling records show an unusual thickness of shale at the position of the "blue band", amounting in some places to 4 or 5 feet. This unusual thickness does not seem to be widespread.

The thickest coal and "blue band" is apparently distributed along the east side of the sharp dip in the east part of T. 7 S., R. 1 W., which is the continuation of the Duquoin anticline of Perry County. Generally in this same region the interval between coals No. 5 and No. 6 is less than it is farther west toward the outcrop. It has been shown (Bull. 15) that in District VI also coal No. 6 is commonly thick where the interval between the two coals is small, and that, as in this district, the roof of the thick coal is commonly a considerable mass of gray shale, the limestone cap rock and black shale not occurring near the coal. It is accordingly supposed that where the bed is thick in the eastern part of Jackson County and adjacent parts of Wil-

liamson and Franklin counties, coal No. 6 was deposited in a shallow basin, which allowed a thicker accumulation than elsewhere. The coal within the basin is one-half to two-thirds thicker than the coal outside the basin; this difference in the amount of shrinkage accounts for the differences in the thickness of the shale between the coal and limestone cap rock.

The following description[2] of coal No. 6 from the Murphysboro-Herrin folio and the accompanying sections of the coal shown in figure 13 are applicable to that part of the quadrangles included within District II.

A clean persistent parting of mother coal lies 14 to 24 inches below the top of the bed, and a second parting generally appears 5 to 8 inches lower down. Above the upper parting the coal is in layers 3 to 6 inches thick, with partings of mother coal between them. Local lenses of mother coal, 6 inches to 5 feet in length and 1 inch to 4 inches thick, are common in the upper third of the bed. Small pyrite lenses and streaks of bone, a few inches to a foot or more in length and one-fourth inch to 1 inch in thickness are found here and there in the middle portion of the bed, a short distance above the "blue band." In the middle and lower parts of the bed the lamination is less distinct but the bedding is still evident.

Above the coal there is a bed of gray, impure shale, 15 to 110 feet thick, the lower part of which generally contains a great number of plant impressions. This shale does not stand well when the coal is removed, and for this reason the 18 to 30 inch zone of coal above the charcoal parting is usually left for a roof until the rooms are mined out, after which it may be taken down. The clay beneath the coal is hard and generally thin, ranging from 4 to 50 inches. It is generally underlain by a limestone and in but few places squeezes enough to cause trouble. Some rock rolls occur at the top, the larger ones extending down into the coal 2 to 3 feet. A distinct cleat is generally present but is not so strong as to prevent the cutting of the coal in any direction desired. The composition and fuel value of this coal are given in the table of analyses.

The quality of coal No. 6 is illustrated by the analyses shown in Table 4 and diagrammatically on Plate III.

The mines of the area are indicated in Table 6.

[2]Shaw, E. W., and Savage, T. E., U. S. Geol. Survey Geol. Atlas, Murphysboro-Herrin folio (No. 185), p. 7, 1912.

TABLE 6.--*List of shipping mines in District II (Jackson County), 1915*

Map No.	Operator	Mine	Coal Worked	Location				Elevation of shaft	Depth to bottom of coal	Altitude of bottom of coal	Average thickness	Production 1915-1916 Fiscal year
					Sec.	T. S.	R. W.					
								Feet	*Feet*	*Feet*	*Inches*	*Tons*
1	Jackson Coal Co.	Jackson	6	NE NW	29	7	1	407	160	247	102	148,567
2	Chicago & Carbondale Coal Co.	No. 1	6	NE	8	8	1	410	79	331	75	*
3	De Soto Peacock Coal Co.	No. 1	6	NE NE	17	8	1	402	52	350	108	18,340
4	Big Muddy Coal & Iron Co.	No. 9	2	SW SE	34	8	2	384	114	270	72	324,273
5	Gartside Coal Co.	No. 3	2	SW SW	33	8	2	416	145	271	48	*
6	Gus Blair Big Muddy Coal Co.	No. 2	2	NW SE	32	8	2	410	135	275	72	55,180
7	Schmidgall Coal Co.	No. 1	2	SE SW	32	8	2	?	98	?	?	*
8	Gartside Coal Co.	No. 4	2	SE SE	29	8	2	?	135	?	72	50,537
9	Gus Blair Big Muddy Coal Co.	No. 1	2	SW NE	29	8	2	416	138	278	48	*
10	Big Muddy Coal & Iron Co.	Harrison	2	NE NW	33	8	2	410	160	250	66	*
11	Cairo Ice & Coal Co.	Simpson	2	NE SE	27	7	3	---	drift	†400	84	*
												596,897

†Approximate
*Abandoned

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